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DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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SOME RUNAWAY CAR TRIPS ON INCLINES AT COAL MINES

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J. J. FORBES AND M. W. VON BERNEWITZ

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DEPARTMENT OF COMMERCE - BUREAU OF MINES

SOME RUNAWAY CAR TRIPS ON INCLINES AT COAL MINES[1]

By J. J. Forbes[2] and M. W. von Bernewitz[3]

PURPOSE OF REPORT

In the United States there are hundreds of underground and surface (inside and outside) inclines at coal mines on which trips of cars are continually being run with coal, rock, supplies, and men. The safety of the men and prevention of damage to the slopes depend, excluding the personal element of the hoist-man, on the strength and condition of the wire cable, draw bars, and the couplings, and on the links of chains and pins as well. Within a recent period of four weeks there have been two runaway trips, one on the surface and one underground; it seems desirable to call attention of mechanical engineers and others at coal mines to the need for closer and more frequent inspection of the cable, draw bars, coupling links and pins, derailing devices, wheels, brakes, and other parts of cars or trips on which men are hauled on inclines. This bureau has never published anything on this class of accident heretofore.

How frequently runaway trips occur is not known. If no serious injury or fatalit has to be reported to the State authorities, a number of such happenings may occur and not be mentioned outside of the immediate vicinity of the mine.

Runaway trips can and do result in considerable loss of life, in injuries, and damage, either at or near the place of the break, or throughout a mine by causing an explosion of gas or coal-dust or both. This report is restricted to a study of the mechanical and physical phases of car trip construction and of the metal of couplings and ropes; derailed trips are not included and may be the subject of another paper. There is no need to mention gas accumulations, coal-dust and rock-dusting, open lights, protected power lines, and permissible equipment, because these have all been well covered in Bureau of Mines publications which have been widely distributed and partly or wholly reprinted by others.

ACKNOWLEDGMENTS

Most of the items regarding the runaway trips tabulated have been abstracted from reports made respectively by Clarence Hall, W.O. Snelling, and J. W. Paul; D. Harrington and J. J. Forbes; H. C. Howarth and G. S. McCaa; K. L. Marshall and E. H. Denny; J. J. Forbes, G. W. Grove, and R. D. Currie; S. P. Howell and K. L. Marshall; and J. W. Paul, H. D. Mason, and G. E. McElroy, all of the mining and safety divisions; and C. H. Herty, jr., and G. R. Fitterer of the metallurgical section of the Bureau of Mines. W. J. Fene, K. L. Marshall,

1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6436."

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and S. P. Howell of the safety division, and J. F. Lessig, mechanical engineer, and G. St. J. Perrott, superintendent, Pittsburgh Experiment Station, read the text and offered suggestions. W. J. McGregor, coroner for Allegheny County, and P. F. Nairn, State Mine Inspector of Pennsylvania, contributed valuable information.

DESCRIPTION OF SOME RUNAWAY TRIPS

Following is a chronological list of a few outstanding occurrences of runaway trips in various fields of the United States.

Typical runaway trips at coal mines

Year	Mine	State	Fatalities and injuries	Occurrence
			Underground runaways	
1907	A	West Virginia	361 killed (all in mine)	Coincident blow-out shot with wreck of 15 loaded runaway cars at foot of slope and consequent dust cloud which was ignited by open lights and caused an explosion.
1922	B	Alabama	90 killed (70 injured)	Runaway trip of three empty cars in rock slope produced a dust cloud which was ignited by an electric arc when the wreckage struck a power cable and caused an explosion.
1927	C	Pennsylvania	4 killed	Runaway trip of 36 loaded cars on semi-gravity plane raised a dust cloud which was ignited when wrecked car wheels came in contact with a power cable and caused an explosion.
1927	D	Colorado	7 killed	Runaway trip of 16 loaded cars was derailed by a drag; power cables and lighting wires were torn down, and the probable arcing (or possibly a carbide light) ignited the coal-dust cloud and started an explosion.
1929	E	Pennsylvania	46 killed (4 injured)	Runaway inclined apron-conveyor loaded with 60 tons of coal raised a dust cloud at bottom of slope and was probably ignited by electric arc, causing an explosion.
1930	F	Pennsylvania	3 killed (47 injured)	Runaway trip of 13 empty cars with men aboard ran 1,200 feet down a slope until wrecked.

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Typical runaway trips at coal mines - Continued

Year	Mine	State	Fatalities and injuries	Occurrence
			Surface runaways	
1915	G	Pennsylvania	9 killed (17 injured)	Runaway trip of 18 loaded cars ran down 1,000-foot incline, left the tipple, and plunged into a group of 27 railway laborers.
1930	H	Pennsylvania	1 killed (1 injured)	Runaway trip of 15 loaded cars ran down a 40° incline, jumped the bin, and landed on loading space near main highway.

Details of Runaway Trips Listed

The following details may be added regarding the disasters listed:

Mine A. - At Mine A the trip had been hauled up the slope about 500 feet in length to a tipple at the opposite side of a river. The trip was partly over the knuckle of the tipple, and presumably, when the remainder of the cars was being pulled up, a coupling pin gave way. The free cars ran down the slope to the bottom and stirred up the dust. There was a derail outside of the slope, but an attendant did not act in time to prevent the cars from going into the mine. It was reported that there had been other runaways on this slope, but without injury to miners.

Mine B. - The haulage system in Mine B was as follows: Coal was transported in tight-gate wooden cars by electric locomotives to the "yard" or parting, which was in line with the slope and had scales, weigh-house, and two empty and two loaded tracks 500 feet long. The slope, about 6 feet high and 20 feet wide, had a pitch of 30° through rock, and intersected the coal bed at 850 feet. From the "yard" the coal was hauled in 5-car trips up the slope to the tipple and there emptied in a double 5-car rotary dump. Cars held 3,600 pounds of coal and weighed 2,200 pounds. Prior to the explosion, one of the cars of a 3-car trip became jammed in the guide rails of the rotary dump on the tipple. A chain block was unsuccessful in pulling back the trip. Then the two front cars were disconnected and pulled forward for a short distance with the hoisting rope disconnected; but in doing this, these two cars ran forward with considerable momentum, dislodged the jammed car, and broke a 60-pound rail which had been placed across the riding ring of the dump to prevent a possible runaway. Then the three cars started back into the slope (a main intake air course) and were wrecked near the foot after a run of more than 850 feet. The wreck caused the rupture of an electric power cable, the arcing of which ignited the coal-dust stirred up by the runaway trip; the resultant coal-dust explosion killed 90 and injured 70 others.

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Mine C. - The explosion in Mine C originated at the foot of a semigravity plane just off the main haulage-road about 6,000 feet from the mine mouth. At the time, a trip of 40 loaded cars was on its way down the north side of the plane; and a trip of 40 empty cars was going up the south side. This plane was doubled-tracked except for a distance of 350 feet at the lower end. When the loaded cars were at a point 1,200 to 1,500 feet from the starting place, the coupling link between the thirty-sixth and thirty-seventh cars parted and allowed 36 cars to run uncontrolled down the plane. Some of the cars were derailed at the end of the double track mentioned, and after traveling about 125 feet off the track they knocked out timbers, which started a fall of roof on the cars. The first 16 cars continued down the plane to the bottom; the other 20 cars were jammed in an entry above the fall and completely blocked it.

Figure 1 shows the broken link from Mine C, reported on by the metallurgical section of the Bureau of Mines. The link was of wrought iron and broke at the welded section; the angle of fracture was similar to that of the angle of weld. Microexamination (30 and 100 magnifications) revealed that the material of this link was extremely dirty even for wrought iron, which contained much slag. Chemical analysis gave 0.091 per cent phosphorus, 0.04 per cent manganese, 0.021 per cent sulphur, and 0.11 per cent silicon. The last three constituents were somewhat lower than in ordinary wrought iron, but the phosphorus content was nearly double that considered good; most of it was in the slag because the iron was highly oxidized. Unoxidized phosphorus is considered to be undesirable to have in any iron because it renders the iron brittle at normal temperatures. It may be concluded that this sample contained a great deal more highly oxidized slag than a good wrought iron; so much slag was present that failure occurred.

Mine D. - Mine D was opened by slopes from which entries were turned at 1,000-foot intervals on the strike of the coal bed. Immediately before the explosion, a broken hitching on the fourth car of a 20-car trip on the main slope allowed 16 cars to run back down the slope, a distance of about 125 feet. The trip had an iron drag on it, 2 by 2 inches by 4 feet in size. This lifted the first car from the track and threw it into a timber on the left side of the slope, after which the runaway cars stopped against the coal rib of a manhole. Power and lighting wires were torn down, and during the clean-up of the slope there was found evidence of arcing on the metal body of one car and on car irons of two cars with wooden bodies; one car hitching was almost burned through. This runaway produced a dust cloud which was ignited either by the arcing or, less probably, by an open carbide lamp worn by the trip rider. Seven persons were killed, and it is probable that had it not been for some rock-dusting done on the slope, the death list would have been greater.

Mine E. - Although the occurrence at Mine E is not strictly a case of runaway cars, it is one of a runaway conveyor carrying coal up a 30° incline 430 feet in length. This conveyor is of the apron type, is 5 feet wide, and when fully loaded holds about 60 tons of coal. It picks up coal from an 8-ton bin under the dump at the foot of the slope. At the time of the disaster the conveyor was full and broke near the head sprocket, rapidly running back the incline to the bottom of the slope.

Figure 2 shows two of the broken links from the apron conveyor at Mine E. These links were examined by the metallurgical section of the Bureau of Mines, but it is not definitely known that the initial fracture occurred in either of these two links. The coroner's inquest revealed that a few days before the disaster, the company's blacksmith repaired the conveyor by welding two links together to make an oversize link. In discussion

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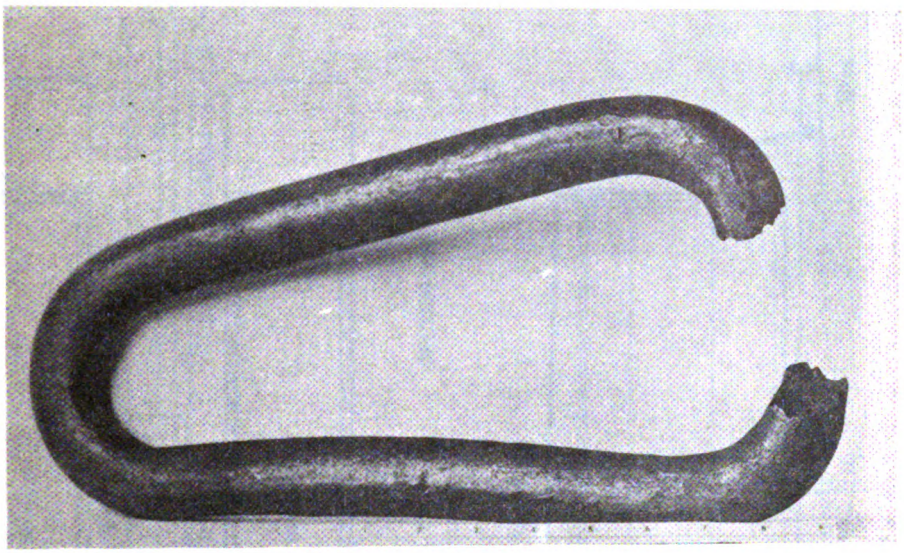

Figure 1.- Broken coupling link that caused the runaway in Mine C

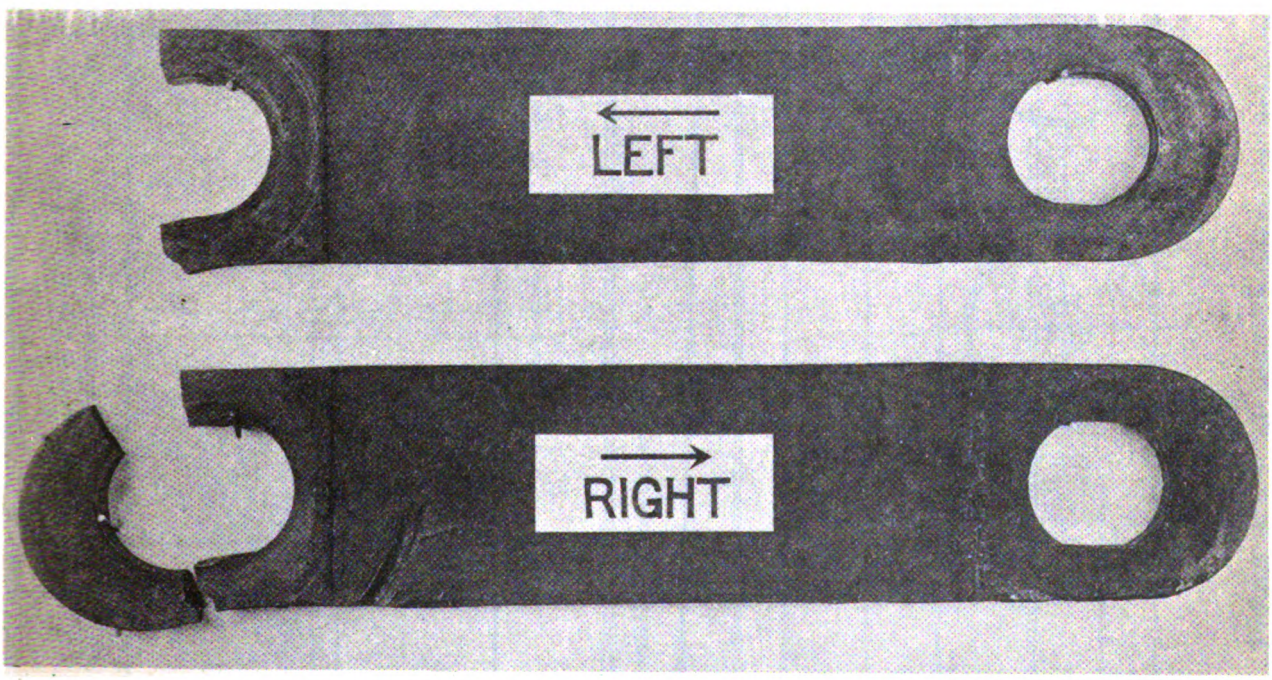

Figure 2.- Broken conveyor links from Mine E

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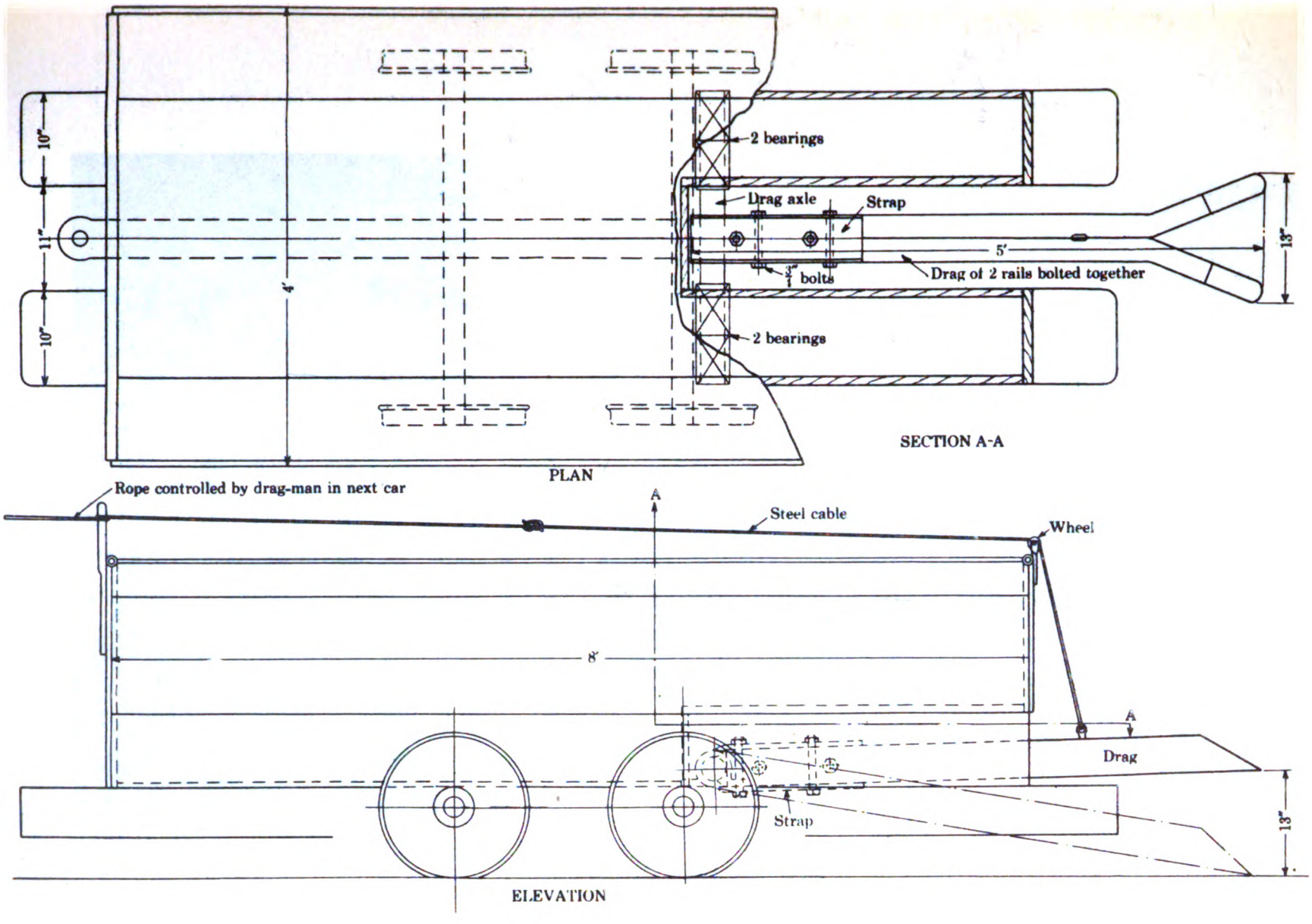

Figure 3.- Plan and elevation of drag car used at Mine F at time of runaway trip

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Figure 4.- Part of coupling link that broke in Mine F. The slag streaks and high-carbon iron are clearly shown in weld and shank

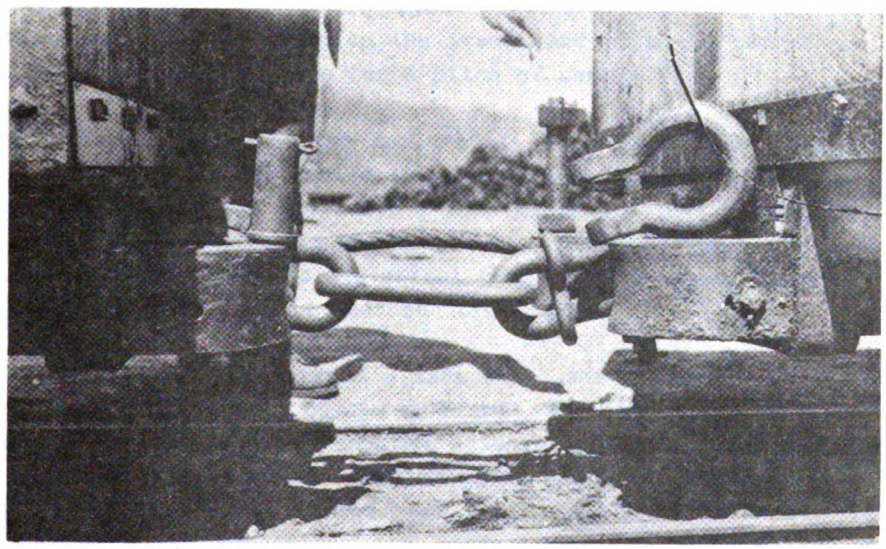

Figure 5.- A safe coupling with split pin in clevis bolt

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of this it may be said that although a weld may be strong in itself, the metal on either side of a weld may be materially weakened by the high temperature employed; hence, this repaired link might have been the initial cause of the runaway conveyor, some of whose links had been in service 12 years.

With regard to the links examined, appreciable amounts of impurities were found in the metal (for a steel containing 0.47 per cent carbon); these appear much like certain silicates resulting from deoxidation of steel with silicon.

Recrystallization had taken place in these chain links, as proved by photomicrographs (500 magnifications) of them and of a link that had never been used. Whereas the new link contained no extraordinarily large crystals of iron, the broken links showed large crystals, probably due to strain and aging. By heating links to 1,600° F. for 30 miutes and cooling in air, a treatment known as normalizing, a small crystal and more uniform metal, considerably strengthened, is produced; therefore, all links or chains which are subject to strain should be periodically normalized.

Mine F. - Fortunately, in this runaway there was not any explosion or fire, but 3 were killed, 47 others injured, and many men had to be extricated from the wrecked trip. The sequence of events is as follows: The day shift was going underground. The man trip had been placed near the top of the slope underground and consisted of 24 empty cars in front of which was a "drag-car." This slope was about 9,000 feet long and had a pitch of nearly 4°. The 190 miners were distributed so as not to exceed 10 men to a car, and a few were in the first two or three cars, but not in the drag-car. The trip had started down a short distance when the center link of a 3-link coupling between the thirteenth and fourteenth cars opened and permitted the front 13 cars and the drag-car to run down the slope. This part of the trip carried 95 men, about half of whom jumped out of the cars when they realized what was happening. The "drag-man" was in the second car, behind the drag-car, holding up the 100-pound drag by means of a cable and rope attached thereto. As soon as he noted the unusual acceleration he is reported to have released the rope which should have released the drag and should have stopped the trip. But the drag did not function in spite of further effort, and he jumped off the trip to outrun it. Eventually, after the trip had run down 1,200 feet of the slope the drag did work, tore up the track, and piled up the cars. Figure 3 shows the drag-car. This part of the slope had a pitch of nearly 5°.

A possible explanation of the failure of the drag to fall is that the rope which held the drag was not free or was fouled in some manner; also, it was disclosed that it had been the practice to hold up the drag with a fish-plate or other suitable piece placed over the bumpers when the car was moved in and out of its night storage place near the top of the slope. Although the evidence was to the effect that this had been removed on the morning of the disaster, it is possible that it had been overlooked.

Figure 4 shows part of the faulty link which was etched with hot hydrochloric acid by the metallurgical section of the Bureau of Mines. The link shows little evidence of wear; the fracture occurred at the weld, and the two adjacent sides appeared to have been separated for some time. An analysis revealed that the metal contained 2.34 per cent slag, close to the 2.5 per cent in normal wrought iron, and this slag contained exactly 10 per cent of silica and 90 per cent ferrous oxide, the correct composition. Figure 4 shows several streaks (white) of high-carbon iron (or steel). Microscopic examination revealed that this contained 0.20 per cent carbon, which is higher than in normal wrought iron. As wrought iron

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and steel do not weld readily, this defect may have caused a poor weld. However, the failure of the link was primarily due to a poor welding practice, aided by nonhomogeneous iron, and possibly by inadequate inspection.

Mine G. - At Mine G there was a new, single-track surface incline from the mine to a new tipple on the railroad, a distance of 1,000 feet with an average grade of 16 per cent. The tipple was at an angle to the right from the tipple approach or trestle. Not far above the trestle, the incline branched to form one track for loaded cars and one for empties, and just below this branch was a safety switch. A new 1½-inch cable attached to a 6-foot drum driven by a 75-horsepower motor hauled the loaded and empty cars. On the afternoon of the accident, a trip of 18 loaded cars had just started down the incline, when the attachment broke between the last car and the haulage rope, and the entire trip of cars ran away down the incline to the tipple. The safety switch near the tipple approach was thrown over by the switch-tender, but it failed to derail the flying trip which swept the full length of the tipple approach and then plunged off the tipple just beyond the point of curvature in the track.

Four men were working on the tipple; two of them managed to escape with slight injuries, but the other two were caught and crushed to death near the dump, where the runaway trip sideswiped the structural steel frame. Forty feet below the tipple, 27 men were ballasting the railroad tracks at a point in line with the approaching trip, but at least 100 feet distant horizontally from the place where the trip leaped from the tipple. The rushing trip of at least 45 tons leaped this entire distance and caught many of the men as it fell. Seven were killed.

An investigation revealed that a break in the clevis to which the trip was coupled had apparently permitted the loaded trip to get away. A piece about 4 inches long had been broken from the eye of the clevis, thus allowing the coupling to slip out and free the trip. The clevis was made from 1½-inch iron and was strongly socketed to the 1½-inch cable. At the point where the fracture occurred there was an inner defect in the welding; the outside rim, however, appeared to be smooth and substantial, so that it would have been difficult to detect this defect by visual inspection.

Mine H. - The situation at Mine H was somewhat similar to that at Mine G, in that the incline slopes toward a well-traveled highway instead of a branch railway. The evidence given at the coroner's inquest and investigation by the State mine inspector revealed that late in the afternoon there was a trip made up of one car of slate and 14 cars of coal and rock. The cars held about 1¼ tons each. The first three cars were on the outside of the pit mouth, the first one being about 60 feet from the safety blocks of the incline plane, which had a 40° grade and was double-tracked. For 90 feet between the pit mouth and the safety blocks of the incline and for another 210 feet in the mine there was a down grade of 2 per cent. The cars were coupled and it was stated that the first seven cars had the brakes set and had 12 sprags in the wheels. The slate car was cut off and dumped on the slate pile 150 feet distant, but as this car was being returned, the mule-driver noticed the trip in motion, sliding along toward the incline plane. He spragged some of the cars and set the brakes on about four of the rear cars, but this did not check the trip, which was derailed at the safety blocks. The 14 cars did not pile up at that point because of the dry and hard condition of the ground, and continued running down the hill. At one point some of the cars were 15 feet from the tracks, but here they struck a bank and veered back onto the track be

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and some of them continued to the tipple. The trip broke on the way down and only 7 cars reached the tipple, one end of which they ripped through; they demolished the weigh office, which was 60 feet in front of the tipple. The shipping clerk was in the weigh office at the time and was struck by flying material which fractured his skull, resulting in death on the following day. In the wreckage the mine superintendent found eight cars with brakes set and nine cars with sprags in; the other cars were so demolished that he was unable to determine whether the brakes were set or if they were spragged.

RUNAWAY CARS IN ROOMS AND ENTRIES

Many rooms in mines are driven to the rise and many on the dip of the coal. In either of these places, single cars have run away and caused injuries to men any where along the track between the room-neck and the face. In either condition a large block should be placed under the wheels, and sprags should be put through them. For a steeper pitch a metal clamp should be attached to the rail to prevent the block from slipping. In addition, a two-pronged iron drag is a safeguard for cars on steep grades. Between 30 and 40 men a year are killed in the United States by car or trip runaways.

RECOMMENDATIONS AND CONCLUSIONS

Engineers of the Bureau of Mines who investigated these and other accidents made the following recommendations as far as haulage was concerned:

1. The suggestion was made for Mine A that derail switches should remain open except when held closed by an attendant during the passage of a trip of cars entering a mine.

2. Derail devices should be placed on the approach to a tipple to prevent, as far as possible, runaway trips from rushing down a slope. This device could be operated by an attendant employed on the tipple. Another derail device should be placed in a slope approximately 100 feet from the point where it intersects a yard or parting, as in Mine B.

3. To prevent such a recurrence as in Mine C, suitable provision should be made for keeping trips of cars under control at all times, or if a coupling or rope breaks, derailment of cars should take place before they have gained much speed. It was suggested (a) that there be systematic inspection for defective couplings, draw bars, and ropes; the two former may be examined by hammer tapping; (b) in addition to strong couplings and pins, all cars run on inclines should have strong safety chains, kept in use at all times, whether on an inclined or level road; (c) derail devices placed at or near the top and at or near the foot of a plane, and controlled from the head-house by the plane-runner, may be used to derail cars in emergency.

4. In the case of Mine D it was proved that a trip derailment on a slope of moderate pitch is likely to raise a cloud of coal-dust, dense enough to be ignited by an arc and cause an explosion. The ordinary drag may not derail the trip until it has gone backward 100 feet or more, and the momentum gained in such distance may be sufficient to cause violent impact and produce a heavy dust-cloud where the cars are wrecked. It was recommended that car couplings receive both visual and mechanical tests at least at 3-month intervals to determine freedom from defects. The couplings should be at least the same diameter as the haulage rope. Safety chains should be attached to all cars and the chains should be used at all times on both loaded and empty trips, whether on a slope or on level track.

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5. No means were provided at Mine E to prevent the conveyor from running back down the incline in case of a break, but there should be some device or devices for doing this.

6. As the drag was unworkable in Mine F at the critical moment, a change in the means of its support was recommended and made. This improvement takes the weight off the control rope, because the drag is now supported by a pin and lever attached to and easily operated by the rope. Other recommendations included the use of special man-trip cars to reduce the hazard of runaways; that brakes be maintained in operating condition at all times; and that a cable through and attached to each car and secured to the haulage rope well above the socket be installed.

7. Frequently, a coroner's jury finds a verdict of accidental death if men have been killed and the cause can not be definitely attributed to anything; seldom is any apparent interest taken or remarks made regarding the mechanical features of a runaway trip. Broken links of couplings are exhibited, but nothing is said concerning the weld. Derail switches are mentioned, but their workability is lightly considered. Broken wire ropes are the prime cause of some runaways, but their condition is hardly questioned. Of course, these features of a runaway are really for action by the State mine inspector, yet the coroner's jury should be alive to their importance.

8. The examination of the chain links described leads to these conclusions: (a) That none but the best wrought iron or steel rod or rounds should be purchased and made into links; (b) that the welding scarf should be properly shaped; (c) that the fire should be clean and a proper welding temperature reached; (d) that if coal is used in a forge it should be low in sulphur to prevent red-shortness in the iron; and (e) that a good flux such as borax be employed, not sand, as is sometimes used.

9. With regard to links for conveyors, none but the best steel bar should be used for repairs and renewals. Holes for the pins or bearing ends should preferably be drilled, not punched.

10. Every trip hauled up a slope should have a loose drag on the rear car to prevent its running back; conversely, every man-trip lowered down a slope should have a controlled drag on the front car.

11. All concerned in a haulage system should be sure that the draw bar, rope, hitchings, couplings, pins, safety chains, derail, and drag are in place, are secure, and in good physical condition.

12. There is a definite need for a reliable automatic derailing device wherever there is slope haulage. The adoption of an automatic derailer not only increases the safety of employees, but it also increases the economic operation of slope haulage by decreasing property damage. A derailing switch of this type, electrically operated, has been installed on the slope joining the mine and tipple a short distance above the tipple landing of Roslyn No. 3 and other mines of the Northwestern Improvement Co., Roslyn, Wash. Information Circular 6226 (January, 1930) of the U. S. Bureau of Mines, by S. H. Ash and R. H. Kudlich, describes this reliable derailer.

13. Hoistmen, whether at steam or electric hoists, should not jerk the haulage rope when it is attached to a trip. Such treatment may cause the breakage of the rope, and also of a chain or pin or other part of a coupling or possibly the draw bar.

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14. As a single-link forged coupling is as safe mechanically as any car hitching, its use is recommended, although a single link is not as flexible as a chain for going around curves.

15. Chains of three or more cast alloy-steel links are procurable and are recommended.

16. It is suggested that as rails are examined by X-rays, the links of coupling chains could also be examined in this manner by makers of chains. Defects would thus be revealed.

TREATMENT AND CARE OF CHAIN

In its NATIONAL METALS HANDBOOK for 1930, the American Society for Steel Treating gives recommended practice for the heat treatment and care of sling and crane chain, and the following items are abstracted therefrom:

1. The reliability of chain depends upon the quality of the welded links and the metal from which they are made.

2. Wrought iron for chain usually has the following approximate chemical composition: carbon, less than 0.05 per cent, manganese, less than 0.10 per cent.

3. The average physical properties of wrought iron for chain are as follows: Tensile strength, 46,000 pounds/square inch; yield point, 23,000 pounds/square inch; elongation in 8 inches, 26 per cent; reduction in area, 40 per cent.

4. To judge the workmanship of a welded fagot, a cold feathering test may be applied by flaring the end of the bar under a hammer. This should show a high degree of ductility and a fibrous, silky fracture free from bright spots.

5. Wrought iron and mild steel should not be mixed or welded together, because they require different temperatures.

6. If a weld has been properly done, the welded portion may not need a normalizing treatment to refine the structure, but with large chain, portions of the link adjacent to the welds have been treated to or near the welding temperature, and if not hot-worked, a weak, coarse, crystalline structure is developed that requires a normalizing treatment for refinement. To do this, the chain is placed in an annealing furnace and covered with a sealed sheet-iron hood to prevent scale formation, until the complete charge is at a temperature of 1,200 to 1,400° F., at which the chain is kept 45 minutes. The time for heating is about three hours. The chain is then withdrawn and allowed to cool in the air.

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7. Overloading is probably the most serious service abuse to which chain is subjected. A new chain may be impaired by overloading the first few times it is used. If a chain is carefully measured at frequent intervals, any elongation that is not the result of wear is sure proof of overload.

8. Improper application of a chain such as a sudden load, or jolt, twisting, kinks, and bending, sets up stresses that are far in excess of those caused by the weight of the load lifted.

9. A safe load for a chain of 1-inch diameter metal is nearly 17,000 pounds; for 1⅛ inches, 20,000 pounds.

10. Don't forget constant and careful inspection.

DETERIORATION AND INSPECTION OF WIRE ROPES

Wire ropes or cables for car trips are subjected to more or less abuse by dragging, jerking, stretching, kinking, weather, and corrosive agencies. Some of this treatment is avoidable, but under normal circumstances a wire rope starts to deteriorate as soon as it is placed on a hoist reel and attached to mine cars. Some ropes drag on the bottom of a slope or incline; others ride on idlers and rollers. When not in use, ropes should not be allowed to lie on the ground; they should be either coiled on the hoist reel or hung up, as is sometimes done to prevent contact with acid water. Wire ropes should be inspected frequently—daily, in fact—and lubricated at frequent intervals. Occasionally the interior should be examined by untwisting, and if the core is dry, the rope should be cleaned and oiled. The socket or eye and clips by which a rope is attached to cars should also be examined for broken wires and other faults. If any are found, the fastening should be cut off and another one attached. If a rope shows an excessive number of broken wires or wear in its length it should either be discarded or a piece cut out for a test of its strength. Where there is any doubt, even by visual inspection, it is wise to discard a wire rope.

COUPLING PINS

Defective coupling pins are a source of accidents in mines. Frequently, badly bent pins are kept in use. Sometimes, they are not inserted properly and result in runaway trips. Coupling pins should be inspected regularly, changed if necessary, and straightened if not bent too much. The pin should be provided with an automatic device to prevent its slipping out of place.

SPRAGS

Wooden sprags are in more or less common use in car wheels underground and on the surface; a short piece of light rail is also suitable. A plentiful supply should be available at all times. If they are too short, men are liable to have their hands injured; if they are too long, sprags project from a car and are liable to strike anyone who might be standing close by. Spragging of cars in lieu of proper blocking is not good practice unless the pitch is low.

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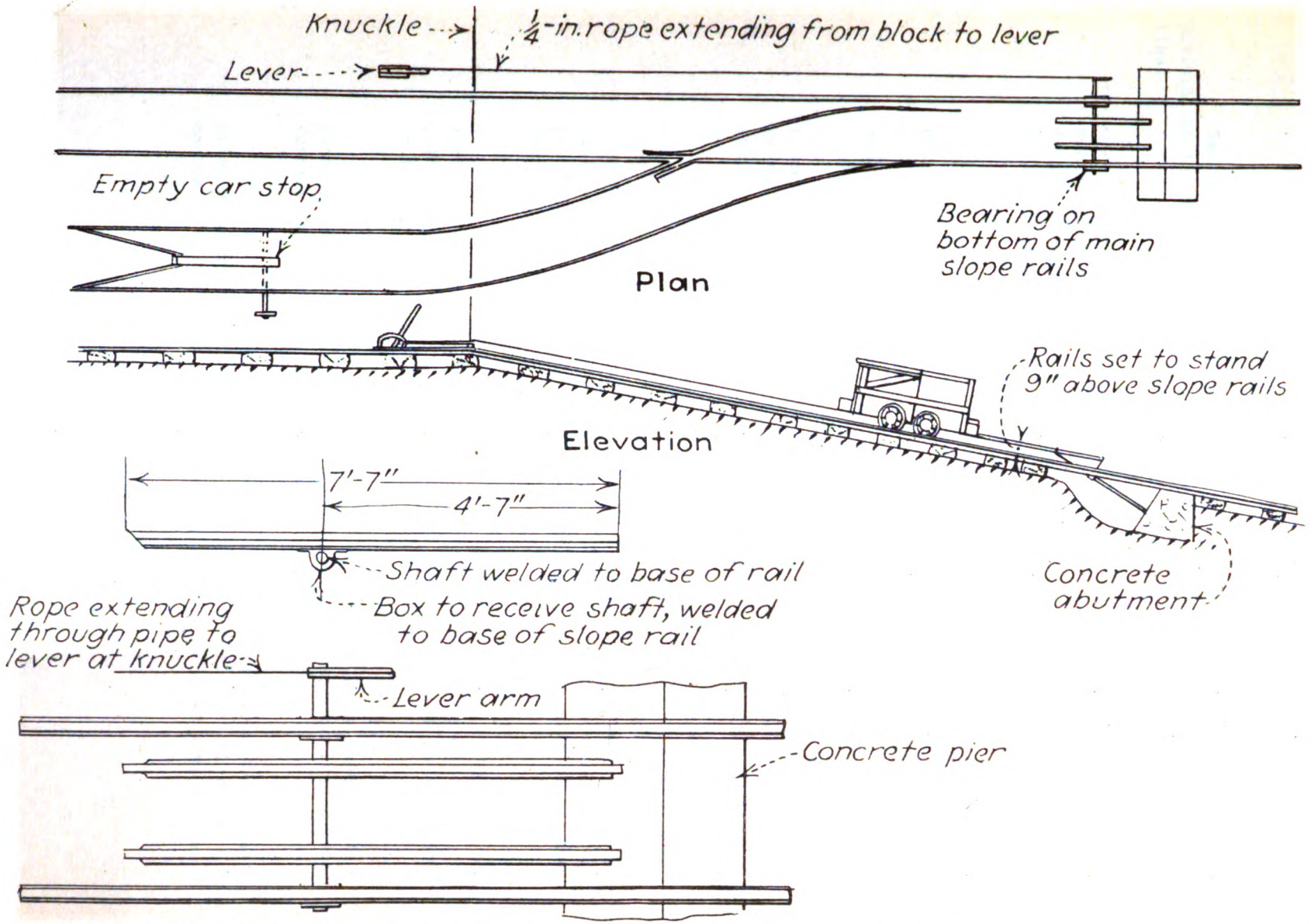

Figure 6.– Safety block at slope entrance to stop possible runaway cars. It must be held open while trips are being lowered into a mine

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SUGGESTIONS FROM THE BUREAU OF MINES ACCIDENT-

PREVENTION COURSE (1930)

Section 4, Haulage Accidents, in the Accident-Prevention Course of the Safety Division of the U. S. Bureau of Mines, now being used in the field, contains the following items:

1. Car brakes, when not properly maintained, constitute serious hazards, such as failure to control cars by depending on the faulty brakes to hold, and failure of some part of the brake rigging while attempting to set brakes may cause the trip-rider to lose his balance or be thrown under the moving trip.

2. There is a large variety of coupling devices in use. None affords complete safety if the coupling is done while cars are in motion, itself a dangerous practice. The principal designs are link and hook; link and pin; two hooks and either single link or multiple link; clevis and links or rigid bar, and male and female design. (See fig. 5.) There are two inherent dangers in all coupling devices—breakage and uncoupling. Breakage can be minimized by selecting suitable sizes, shapes, and metal; discarding the couplings when worn, and inspecting with heat treatment at intervals.

3. To avoid accidents from breakage of the main coupling, an additional sturdy coupling of the car to the rope above the main coupling is frequently used. To avoid accidents caused by one or more cars breaking loose, a 1-inch wire rope is sometimes run above or under and fastened to each car of a man trip. In some western coal mines, all pit cars have safety chains in addition to and independent of the draw bars and couplings.

4. Drags are much used on loaded trips on slopes, and on grades in locomotive haulage. To prevent the drags from knocking out rollers, the drag may be placed to the side rather than to the center of the car.

5. Every producing entry which is on a grade should have a runaway switch, outby the first working or producing place, to prevent runaway cars from running back down the grade.

6. A safety block such as shown in Figure 6 should be provided at slope entrances to stop possible runaway cars and trips. Of course it must be held open when trips are being lowered into a mine.

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